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IMPACT OF SOCIAL/TRADITIONAL MEDIA ON POLITICAL POLARIZATION

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1. INTRODUCTION

Political polarization is apparent in the American society today. It is true that the American people have always had very diverse political views and some experts in recent past thought that political polarization in the US was no worse than before [2, 3]. However, the perception that political polarization is increasing in the American society is almost universal in mainstream media with some quantitative evidence [4, 5, 6, 7]. Often the blame is assigned to the rise of social media as the major influencer of the political opinion in the US [8, 9, 10, 11].

In today's world, social media plays a huge role in providing political commentary to the people [12]. People no longer depend on the traditional media (e.g. newspapers, magazines, TV/radio channels) to get opinion on political matters. Social media makes it possible for any one to share their opinions with large sections of the society. Both traditional and social media companies want to maximize their advertisement revenue and hence want to maximize the time people spend with their content. With this objective in mind, a traditional media company decides who their target audience is and tailors its content to appeal to that audience. Social media companies go one step further and use elaborate machine learning algorithms to customize the content an individual sees to appeal to their specific bias.

Machine learning helps a social media company estimate the political views of its users individually and identify the content liked by the users with specific views. The social media platform then presents each user with the content most likely to appeal to them. The machine learning algorithms are designed to maximize the user's engagement with the platform and often fail to prevent falsehoods or other content of extreme nature from being presented to large number of users. Social media companies have no penalty to pay from legal perspective for presenting such content to their users. Section 230 of the Communications Decency Act of 1996 protects social media companies from any legal liability for any content on their platforms not explicitly created by the company. In fact, some social media companies may be knowingly presenting extreme content to the users because such content is known to grab the users' attention and hence increase their engagement with the platform. Many people use social media as their main source for getting political news & opinions and are clearly susceptible to adopting extreme political views because of their constant exposure to such views.

However, some experts push back against the narrative above. Several arguments have been presented to counter the notion that social media is responsible for the rise in political polarization in the US:

- Polarization in the US has been increasing since 1990s much before the advent of social media [13].
- The rise in polarization is most evident among older Americans, who are less likely to use social media [14, 15].

- Rather than providing *echo chambers*, where people just hear views similar to their own, social media exposes people to politically diverse views, which may reduce mass political polarization [16, 17, 18].
- Exposure to opposing political views does not necessarily lead to moderation [19, 20]. Political views meant to "rally the base" may actually cause further alienation among people with opposing viewpoint.
- The number of *fake news* stories seen by an average American is not significant and is unlikely to have a significant impression on the viewers' political thinking [21].

Also, research literature points to other possible causes of polarization such as emergence of highly partisan traditional media, increasing racial divisions & economic inequality in the US and the impact of trade globalization [13, 22].

2. MATERIALS AND METHODS

Clearly, social (and traditional) media has a complex relationship with political polarization in the society and we do not yet understand this relationship very well. This paper is an attempt to understand this relationship via simulations. Specifically, we aim to understand the conditions under which social and traditional media may cause noticeable increase or decrease in political polarization. In particular, we want to understand the role of *echo chambers*, which by definition provides political views within a narrow range. For this purpose, we created a software simulation framework [1] where the political *shades* of the individuals in a population change as a result of their encounters (e.g. reading an article or watching a video) with social and traditional media.

2.1. Political Shade of an Individual.

In our simulation framework, the entire spectrum of views on a set of political issues is modeled as a range of values between 0 and 10. The political *shade* of an individual is a value in this range. Shade values 0 and 10 represent most extreme political views in opposite directions (e.g. *Far-Left* and *Far-Right*) and a shade of 5 represents moderate/centrist political views. In our simulations, we interpret the political shade as representing an individual's position on the entirety of issues although it is possible to interpret the shade value as political views on a specific issue (e.g. gun control) only. The political shade of an individual (*individualShade*) is modeled as the weighted average of a core immutable component (*coreShade*) and a second component (*acquiredShade*) that changes in accordance with the social and traditional media encounters the individual has:

$$individualShade = \alpha \times coreShade + (1 - \alpha) \times acquiredShade$$

, where $0 \leq \alpha \leq 1$.

2.2. Encounters with Social/Traditional Media.

Like individuals, the social/traditional media encounters are also characterized by political shades in accordance with political views they represent. In a simulation, each individual in the population goes through a specified number of media encounters, which is an input parameter to the simulation (see Table 1 for a list of all input parameters). In our simulation framework, the probability that a media encounter involves an *echo chamber* is a configurable parameter. Based on the value of this

probability, a media encounter is either an echo chamber encounter or a *non* echo chamber encounter. In an echo chamber encounter, an individual basically comes across shades very similar to their own with a possible tilt towards the extreme. Other encounters may expose the individual to a diversity of political shades (e.g. normally distributed around the center to represent moderate unipolar media, bi-normal distribution to represent partisan media with two poles).

Depending on an input parameter to the simulation, an echo chamber encounter has a shade that either is within a tight range around the individual's shade (normally distributed with the individual's shade as mean and $2.5/6$ as standard deviation)¹ or more extreme than the individual's shade. Depending on another input parameter, a media encounter that is not an echo chamber encounter is either a unipolar media encounter (political shade normally distributed with mean 5.0 and standard deviation $10.0/6.0^2$) or a bi-polar media encounter (political shade drawn from one of two normal distributions with equal probability: Normal(mean 2.5, std dev $5.0/6.0$) or Normal(mean 7.5, std dev $5.0/6.0$)). Figure 1 shows the distribution of political shades for encounters with unipolar and bi-polar media.

¹For a normally distributed random variable, 99.7% of the sample values will be within three standard deviations of the mean.

²Note that this distribution will have 99.7% of the values within the range 0 to 10.0.

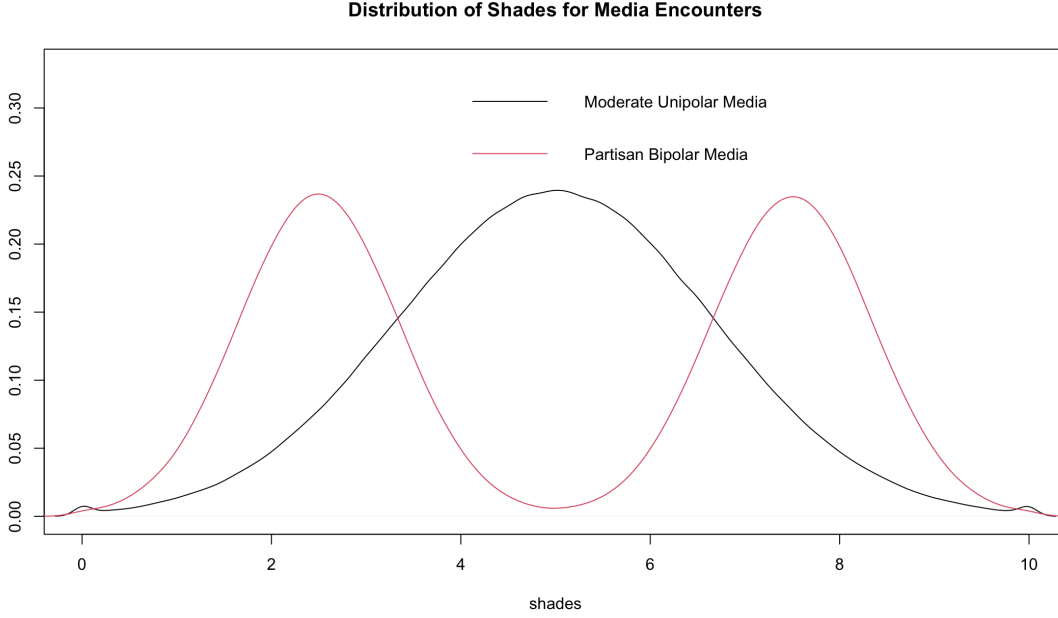


FIGURE 1. Distribution of shades for encounters with unipolar and bi-polar media.

In addition to their shade, the social/traditional media encounters are further characterized by their nature - whether they are meant to *Rally the Base* or *Build Bridges* across the political divide. In our simulation model, an individual's *acquired-Shade* changes in different ways based on the nature of a media encounter. A media encounter with a persuasive *Build Bridges* message attracts an individual towards its shade by adding/subtracting a small value (β) to/from the individual's *acquired-Shade*. On the other hand, an encounter with a *Rally the Base* message will only impact individuals in the same *base* as this message. In our simulation framework, the *base* associated with a message is the set of individuals with shades in a small

range (± 2.0) around the shade of the message. Individuals outside this base are not impacted at all by such a message.

As mentioned before, the shade associated with an echo chamber encounter is close to the individual's current shade with a possible tilt towards the extreme. The simulation framework uses an input parameter to determine if the echo chambers have a tilt towards the extreme. If they do, the shade of an echo chamber encounter is influenced by the shade of the individual (*individualShade*). If the *individualShade* is less than 5.0, the shade of the echo chamber encounter is picked from a normal distribution with mean $0.5 \times \text{individualShade}$ and standard deviation 2.5/6.0. On the other hand, if the *individualShade* is more than 5.0, the shade of the echo chamber encounter is picked from a normal distribution with mean $0.5 \times (\text{individualShade} + 10.0)$ and standard deviation 2.5/6.0. Persistent encounters with such echo chambers will move the individuals towards extreme shades. Further, the simulation framework allows for the echo chambers to be addictive (via another input parameter). This means that an encounter with an echo chamber will increase the probability of another echo chamber encounter by a value (another input parameter). Finally, by their very nature, all echo chamber encounters offer only *Rally the Base* messages. The complete list of all input parameters to a simulation can be seen in Table 1.

A simulation involves each individual in the population going through the specified number of media encounters under the conditions specified by the input parameters. These encounters will modify the shade of each individual. We visually compare the shade distribution of the population at the end of the simulation with that at the beginning. We repeat each simulation with multiple different seeds for random

number generation to ensure that the results do not depend on a particular sequence of generated random numbers.

TABLE 1. Input Parameters to a Simulation

Nature of Echo Chamber Encounters
1: Show content with shades in a tight range around the individual's shade.
2: Show contents that are more extreme than the individual's shade.
Shades of <i>non</i> Echo Chamber Encounters
1: Normally distributed with mean 5.0 and std dev 10.0/6.0
2: Either Normal(mean 2.5, stddev 5.0/6.0) or Normal(mean 7.5, stddev 5.0/6.0) with equal probability.
Probability that a Media Encounter is an Echo Chamber Encounter
Is Echo Chamber Addictive?
Increase in the Probability that a future Media Encounter is an Echo Chamber Encounter (when an individual has an encounter with an addictive Echo Chamber)
Probability that a <i>non</i> Echo Chamber Encounter is a <i>Build Bridges</i> Encounter
Number of Media Encounters for Each Individual in the Population
Weight associated with the <i>coreShade</i> of an individual (α)
Change in the <i>acquiredShade</i> when an individual has a media encounter (β)
Seed for Random Number Generation

3. RESULTS

In this section, we report representative results from our simulations. These simulations were done on a population of 10000 individuals with initial core/acquired shades that are picked from a normal distribution with mean 5.0 and standard deviation 10.0/6.0 with values less than 0 or more than 10.0 changed to 0 and 10.0 respectively. Figure 2 shows the distribution of initial core/acquired shades of 10000 individuals.

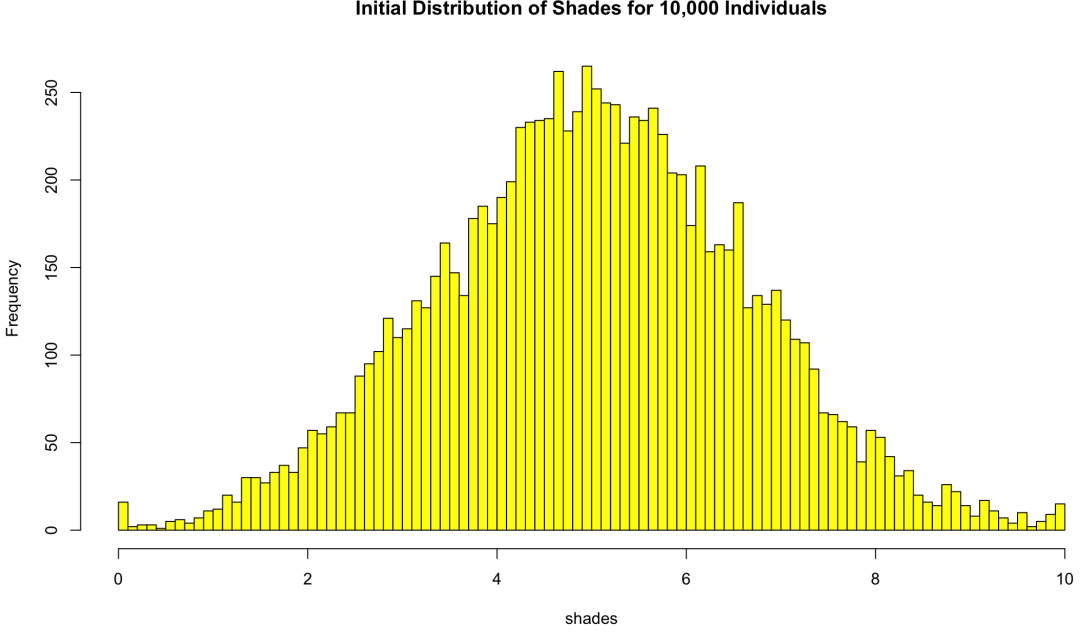


FIGURE 2. Distribution of initial core/acquired shades of 10000 individuals at the beginning of each simulation.

We used 0.5 as the value of α in these simulations. In other words, the *individualShade* of each individual is calculated in the following manner.

$$individualShade = 0.5 \times coreShade + 0.5 \times acquiredShade$$

As mentioned before, the *coreShade* of an individual does not change whereas the *acquiredShade* changes as per the media encounter the individual has. In these simulations, each individual had 200000 media encounters. We used 0.0001 as the value of β in these simulations. This means that the *acquiredShade* of an individual changed by 0.0001 (towards the shade of the media encounter) when an individual has a media encounter. Further, the fraction of *Build Bridges* encounters in *non*

echo chamber encounters was 0.5, i.e., half of the *non* echo chamber encounters had a *Build Bridges* message. All the simulations reported here used a particular value as the seed for random number generation³.

3.1. Simulation 1: Encounters with Unipolar Media with No Echo Chambers.

In the first simulation, each individual had 200000 encounters with unipolar media with political shades shown in Figure 1. As mentioned before, the distribution of initial core/acquired shades of these individuals can be seen in Figure 2. The media encounters changed the acquired shades of each individual. The distribution of final shades of 10000 individuals at the end of the simulation can be seen in Figure 3. Comparing the distributions in Figure 2 and Figure 3, we can see that encounters with a unipolar media alone causes the range of shades to shrink towards the pole. To confirm this behavior, we repeated this simulation with initial core/acquired shades picked from a uniform distribution shown in Figure 4. The final distribution at the end of this simulation is shown in Figure 5. Again, we see that the range of shades in the population shrinks when the individuals in the population interact with a unipolar media alone.

³All simulations were repeated for several different seeds for random number generation. We double-checked that the observations made here remain valid irrespective of the seed value used.

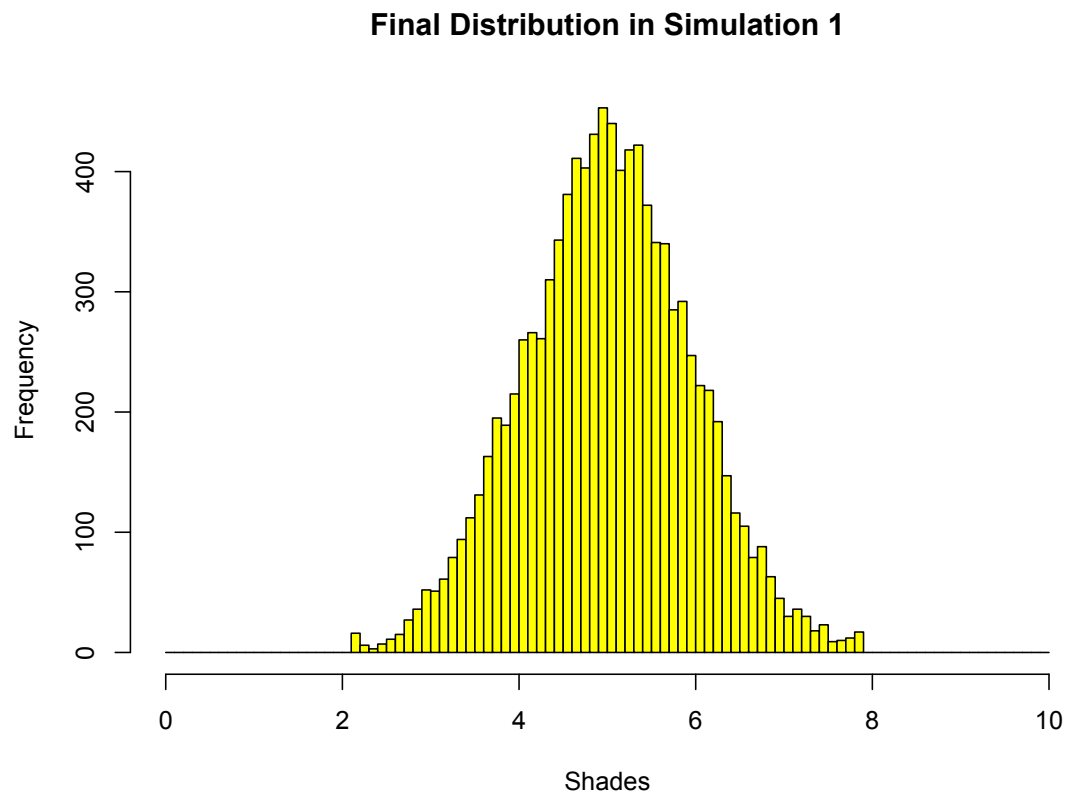


FIGURE 3. Final distribution of shades of 10000 individuals at the end of Simulation 1 (Unipolar Media, No Echo Chambers).

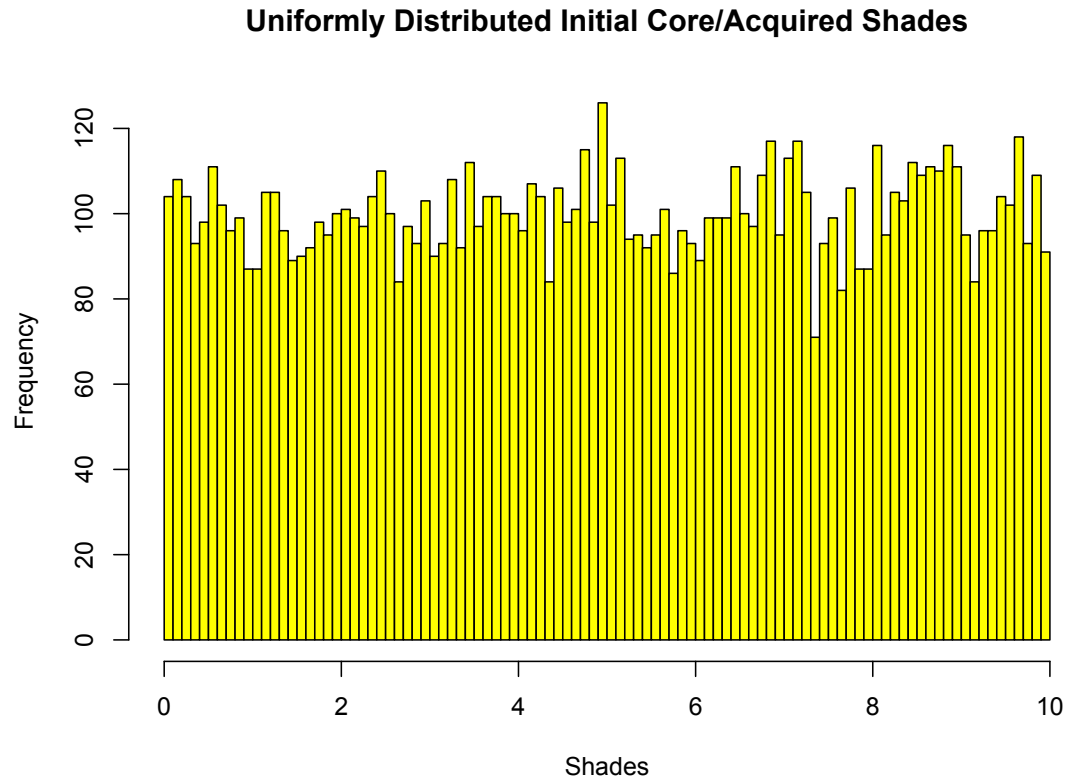


FIGURE 4. Uniformly distributed initial core/acquired shades of 10000 individuals.

Final Distribution in Simulation 1 When Initial Distribution is Uniform

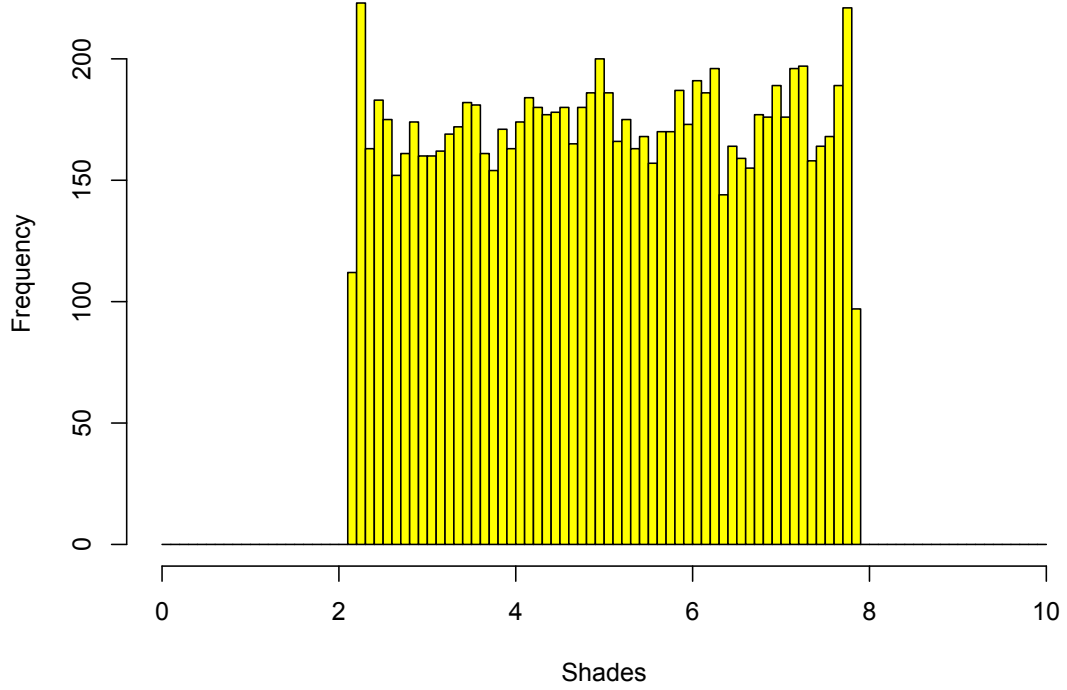


FIGURE 5. Final distribution of shades of 10000 individuals at the end of Simulation 1 (Unipolar Media, No Echo Chambers) when initial shades were uniformly distributed.

3.2. Simulation 2: Encounters with Bi-polar Media with No Echo Chambers.

In the second simulation, each individual had 200000 encounters with bipolar media with political shades shown in Figure 1. As in the first simulation, the distribution of initial core/acquired shades of these individuals can be seen in Figure 2.

Encounters with the bi-polar media changed the shades of 10000 individuals in the population in the manner shown in Figure 6. Note the significant difference between initial distribution (Figure 2) and the final distribution at the end of the simulation (Figure 6). While the initial distribution is unipolar, the final distribution is clearly bi-polar and somewhat resembles the bi-polar distribution of the media encounters. In Simulation 1, we saw that the final distribution shrinks towards the single pole of the distribution of media encounters. So, it seems that the distribution of shades in a population tends to assume the shape of the distribution of shades of encountered media. This behavior is of course a consequence of the manner we change the *acquiredShade* in our simulation framework. However, this behavior is also consistent with what we have seen in the real world, where public opinions tend to align with those expressed in popular media. So, our simple simulation framework does provide a simple explanation of the real-world observation that high level of partisanship in popular media will have direct impact on polarization in the society.

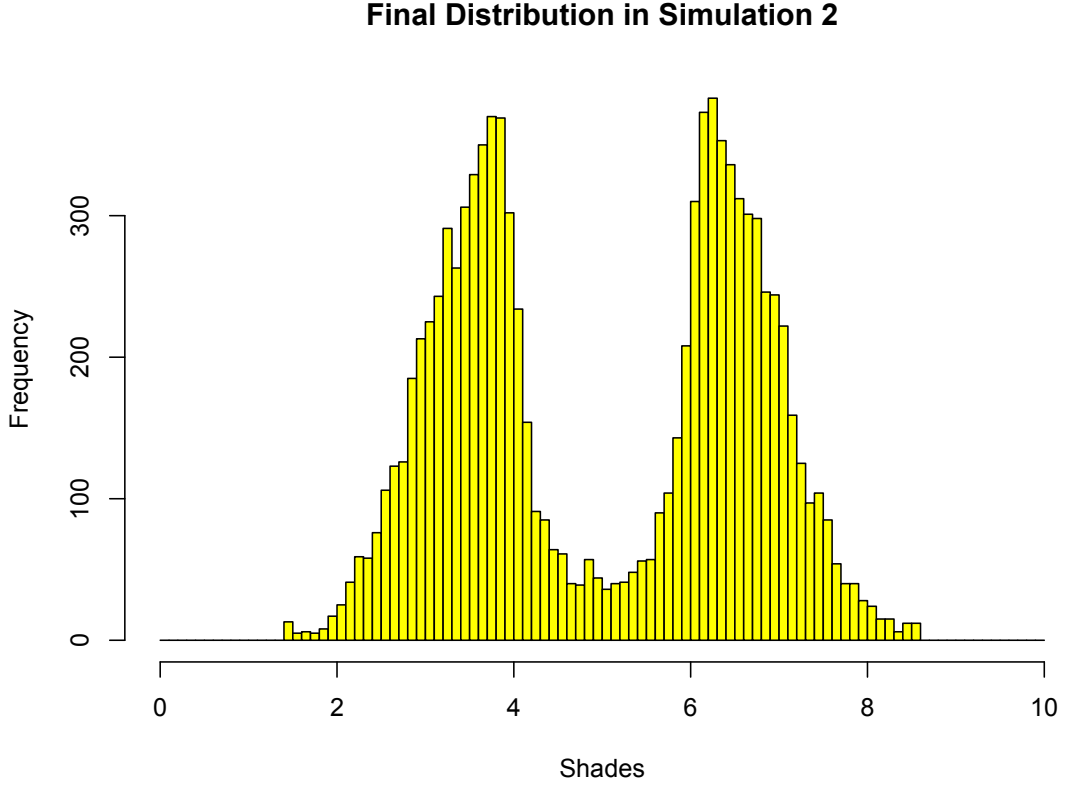


FIGURE 6. Final distribution of shades of 10000 individuals at the end of Simulation 2 (Bipolar Media, No Echo Chambers).

3.3. Simulation 3: 90% of Encounters with Bi-polar Media, 10% Encounters with non-Addictive Echo Chambers with No Tilt towards Extreme.

In the third simulation, 90% of the media encounters that each individual has are with bipolar media and 10% of the encounters are with echo chambers that are not addictive and do not have any tilt towards the extreme. The distribution of shades in the population at the end of this simulation are shown in Figure 7. The only difference

between this simulation and the previous one is that each individual in this simulation has 10% of the encounters with echo chambers that are not addictive and do not have any tilt towards the extreme. So, an individual will hear opinions very similar to their own in these echo chamber encounters and hence these encounters will not have much impact of the political shades of the individuals. Political shades will only change significantly because of encounters with bipolar non-EchoChamber media. Since individuals in this simulation has fewer bipolar media encounters than individuals in the previous simulation, the final distribution of shades in this simulation (Figure 7) is less bipolar than what it was in the previous simulation (Figure 6). Clearly, echo chambers with no tilt towards extreme helped alleviate the impact of bipolar media. This is a surprising result. So far, we viewed echo chambers as the main culprit in causing polarization in the society. It turns out that **echo chambers can actually help alleviate the impact of polarizing contents in other media as long as echo chambers show content that reflects viewer's current shade and do not show extreme content.**

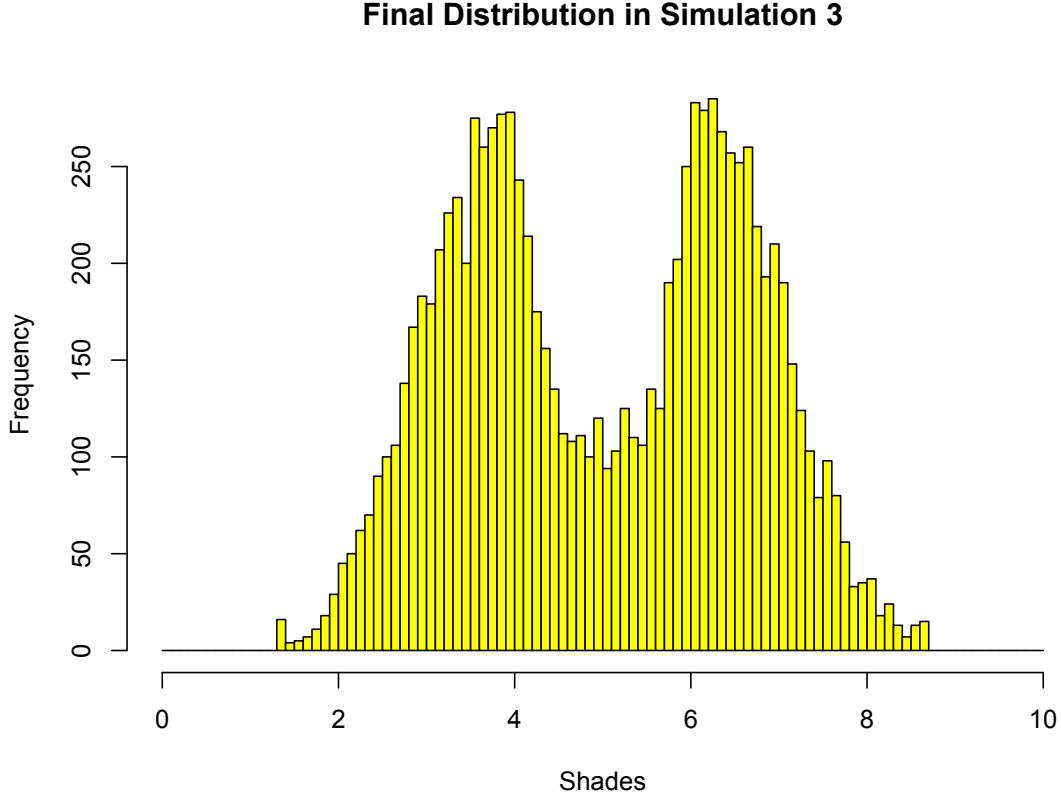


FIGURE 7. Final distribution of shades of 10000 individuals at the end of Simulation 3 (90% of Encounters with Bipolar Media, 10% with non-Addictive Echo Chambers with no tilt towards extreme).

3.4. Simulation 4: Encounters with Addictive Echo Chambers with No Tilt towards Extreme.

In the fourth simulation, the individuals have encounters with *addictive* echo chambers. This means that the probability of having another echo chamber encounter increases for an individual whenever they have an echo chamber encounter. In this

simulation, the probability of having an echo chamber encounter gets multiplied by a factor (1.0001) whenever the individual has an echo chamber encounter. The initial probability for an echo chamber encounter is 10% for all individuals. All non echo chamber encounters are with bipolar media as before. The addictive nature of the echo chambers means that the probability of echo chamber encounters for an individual quickly approaches 1. Since an echo chamber shows contents with roughly the same shade that the individual currently has, there is not much change in the shades of the individuals at the end of the simulation. This is clear in Figure 8 that shows the final distribution of the shades in the population at the end of Simulation 4. Note that the final distribution looks very similar to the initial distribution (Figure 2). **Addictive echo chambers with no tilt towards extreme prevented bipolar media from causing polarization in the society.**

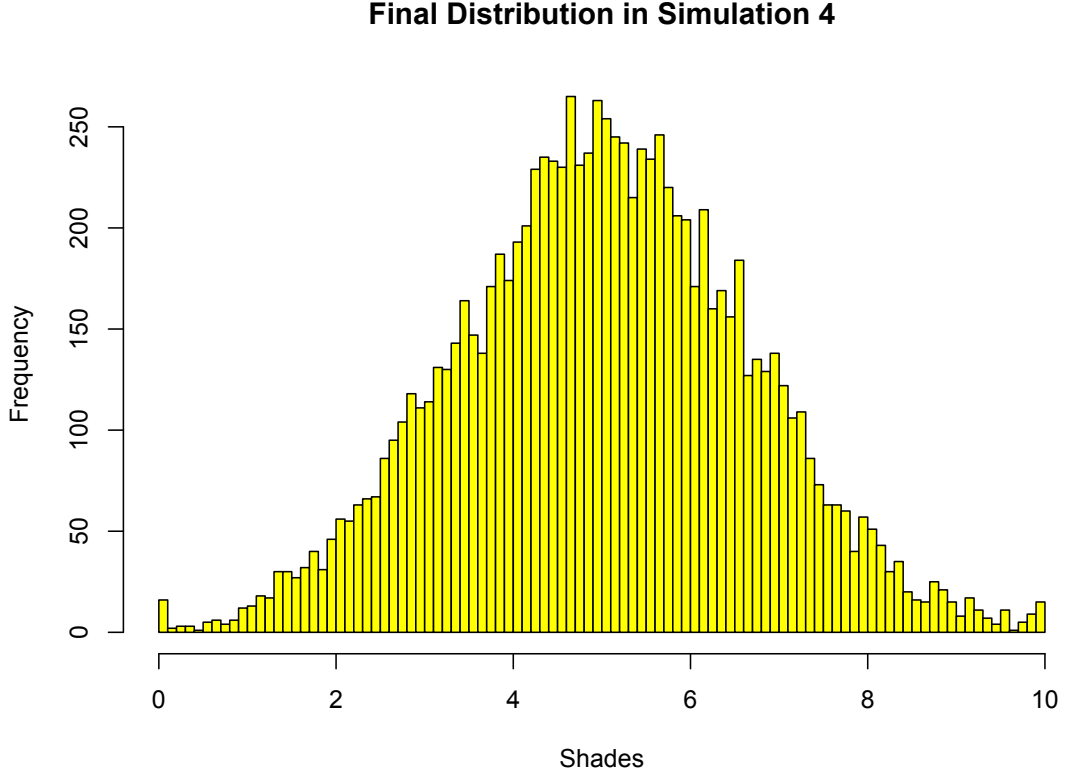


FIGURE 8. Final distribution of shades of 10000 individuals at the end of Simulation 4 (Addictive Echo Chambers with no tilt towards extreme).

3.5. Simulation 5: 90% of Encounters with Bi-polar Media, 10% Encounters with non-Addictive Echo Chambers with a Tilt towards Extreme.

In the fifth simulation, we return to the configuration of the third simulation with one important difference: the echo chambers have a tilt towards showing extreme content. In this simulation, 90% of the media encounters that each individual has are

with bipolar media and 10% of the encounters are with echo chambers that are not addictive but do have a tilt towards showing extreme content. If the *individualShade* is less than 5.0, the shade of the echo chamber encounter is picked from a normal distribution with mean $0.5 \times \textit{individualShade}$ and standard deviation 2.5/6.0. On the other hand, if the *individualShade* is more than 5.0, the shade of the echo chamber encounter is picked from a normal distribution with mean $0.5 \times (\textit{individualShade} + 10.0)$ and standard deviation 2.5/6.0. So, these echo chambers expose an individual to extreme views in the direction the individual tends to lean. The distribution of shades in the population at the end of this simulation are shown in Figure 9. This figure should be compared to Figure 6 that shows the distribution of shades in the population when the individuals have all their encounters with bipolar media. Clearly, having just 10% of the encounters with echo chambers showing extreme content causes the polarization in the population to become worse. In the next subsection, we will see what happens when the echo chambers are not only showing extreme contents but are addictive as well.

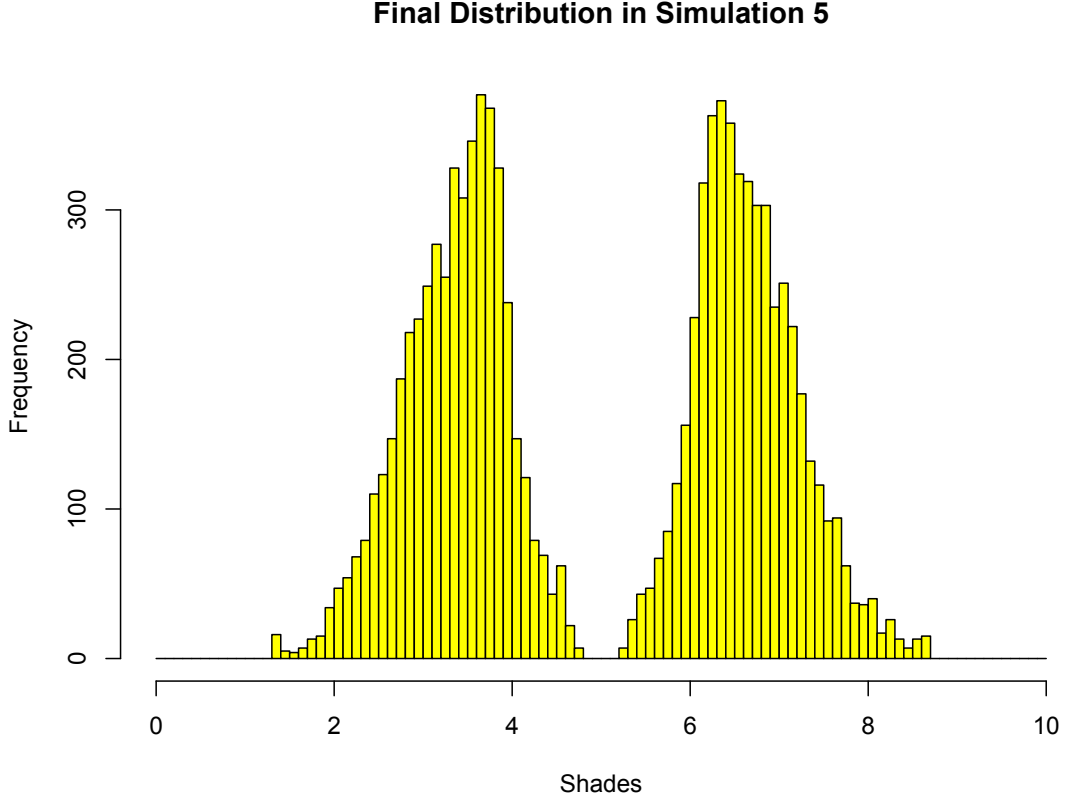


FIGURE 9. Final distribution of shades of 10000 individuals at the end of Simulation 5 (90% of Encounters with Bipolar Media, 10% with non-Addictive Echo Chambers with a tilt towards extreme).).

3.6. Simulation 6: Encounters with Addictive Echo Chambers with a Tilt towards Extreme.

In the final simulation, the echo chambers show extreme contents and are addictive as well. Initially, the probability of having an echo chamber encounter is 10% for each individual in the population. This probability gets multiplied by a factor

(1.0001) whenever the individual has an echo chamber encounter. This means that the probability of echo chamber encounters for an individual quickly approaches 1. These echo chambers show extreme content to the individual in the manner described previously. So, in this simulation, the individuals quickly get stuck in echo chambers that expose them to very toxic views. The final distribution of the shades in the population at the end of this simulation are shown in Figure 10. As expected, this simulation ends in extreme polarization in the population with no individual left with moderate views. These results imply that addictive echo chambers that bombard their viewers with extreme content can rip any society apart.

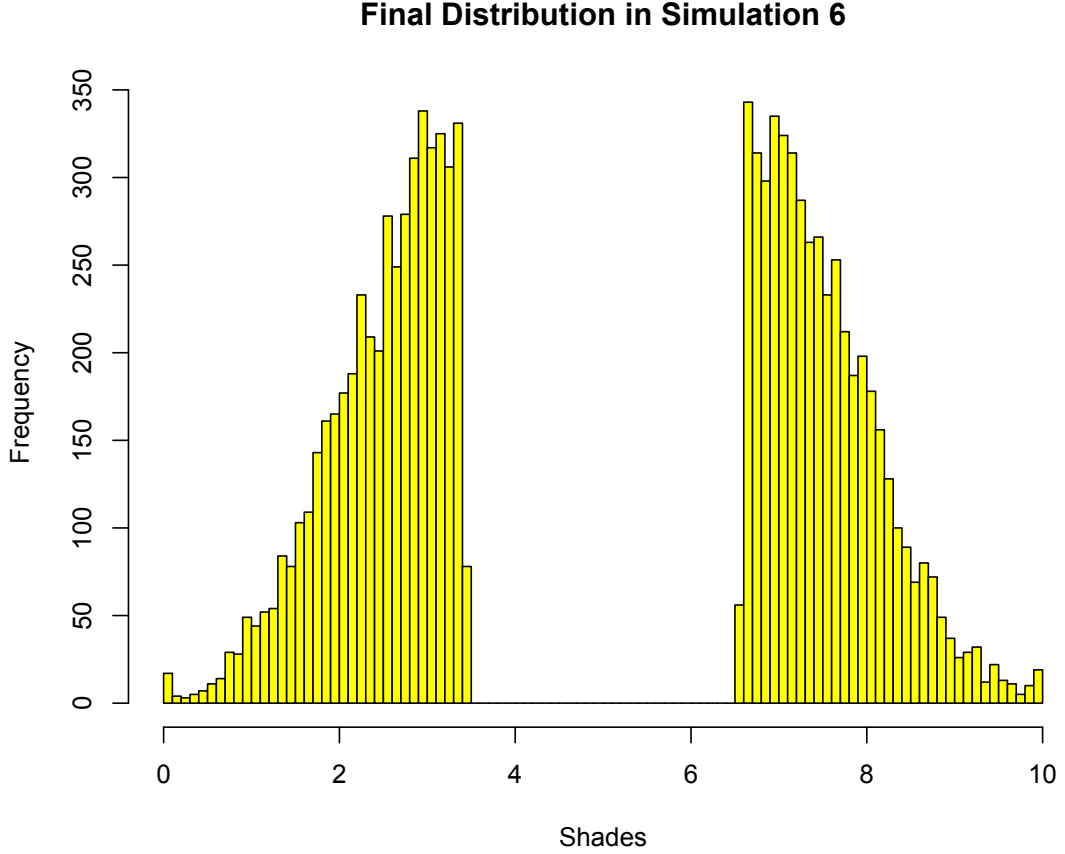


FIGURE 10. Final distribution of shades of 10000 individuals at the end of Simulation 6 (Addictive Echo Chambers with a tilt towards extreme).

4. DISCUSSION AND CONCLUSIONS

In this paper, we used simulations to study the impact of partisanship in the traditional/social media on political polarization in a society. In particular, we investigated the role machine-learning powered echo chambers can play in improving

or worsening this situation. Our simulations confirm that partisanship in traditional/social media directly impacts political polarization in the society. If a society is only exposed to unipolar views in media (as it probably happens in countries where the government has strict control over the media), the society as a whole will slowly converge to a unipolar distribution of political views among its citizens. On the other hand, if the media is bipolar, the society will also become bipolar over time. Traditional media like newspapers and TV channels show the same content to all their users irrespective of their political shades. However, social media (e.g. Facebook, Twitter and YouTube) have the ability to use machine learning to sense the political shade of an individual user and show them customized content that aligns with their views. Social media platforms also exploit machine learning to make their users get addicted to the platform. Our simulations indicate that such *echo chambers* can actually alleviate the impact of highly partisan traditional media as long as they do not show extreme content to their users. However, if the social media echo chambers actually use extreme content as the main way to hook the users to their platform they can cause extreme polarization in a society.

Our research is clearly important for the American society. Political polarization of the kind we have seen in recent years possibly presents an existential threat to United States. There is a growing realization of the dangers of extreme content reaching a large number of vulnerable people because of amplification by the social media echo chambers. So, there have been calls to regulate the social media. At the same time, America loves its freedom of speech. Freedom of speech enjoyed by Americans is not available in many countries (including democratic ones). So, Americans want to preserve their freedom of speech and many people think that any

regulation of social media is equivalent to curbing the freedom of speech. Clearly, we Americans are in a difficult situation. One possible solution to our dilemma may be to remove Section 230 granted legal protection that social media companies currently enjoy. Removing this protection may force social media companies to remove extreme contents (that are typically false) from circulation. Another solution may be to require a social media platform to clearly inform the users regarding the nature of the content recommendation algorithms and seek the user's explicit permission before using a specific algorithm. Such a requirement may allow many users to completely escape echo chambers and extreme content on social media. Clearly, there is a need to carefully investigate the good and bad consequences of these and other proposals to solve this problem.

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